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# GEOGRAPHICAL INFLUENCES IN THE DEVELOPMENT OF WISCONSIN *

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## CHAPTER I. GEOLOGICAL AND GEOGRAPHICAL CONDITIONS AFFECTING THE DEVELOPMENT OF WISCONSIN

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The early history of a country depends in large measure on its location and physical characteristics. These factors, together with the character of the surrounding region, determine for a country its climate, drainage, products, and relation to the rest of the world.

The most important factor in the early history of Wisconsin was its key position between the Upper Great Lakes and the Mississippi River. Within the state these great water systems approach each other so closely that in places their flood waters mingle and a canoe may pass from one to the other without a portage. Upon

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* Originally presented as a thesis for the degree of Master of Science at the University of Chicago in 1910; later revised to its present form. The paper embraces seven chapters. Chapters II to VII will follow in the next six numbers of the *Bulletin*.—ED.

this peculiar location depended the early discovery, exploration, and settlement of Wisconsin.

The northern part of Wisconsin is underlain by pre-Cambrian crystalline rocks, more or less covered by drift. Granitic rocks outcrop over the central portion of this area, and adjacent to them are the iron-bearing Huronian formations. The latter outcrop along the Menominee River and in a narrow strip extending thence southwest to the Wisconsin River. They are exposed at the north in the Penokee Iron Range and at the west in Barron and Burnet Coun-

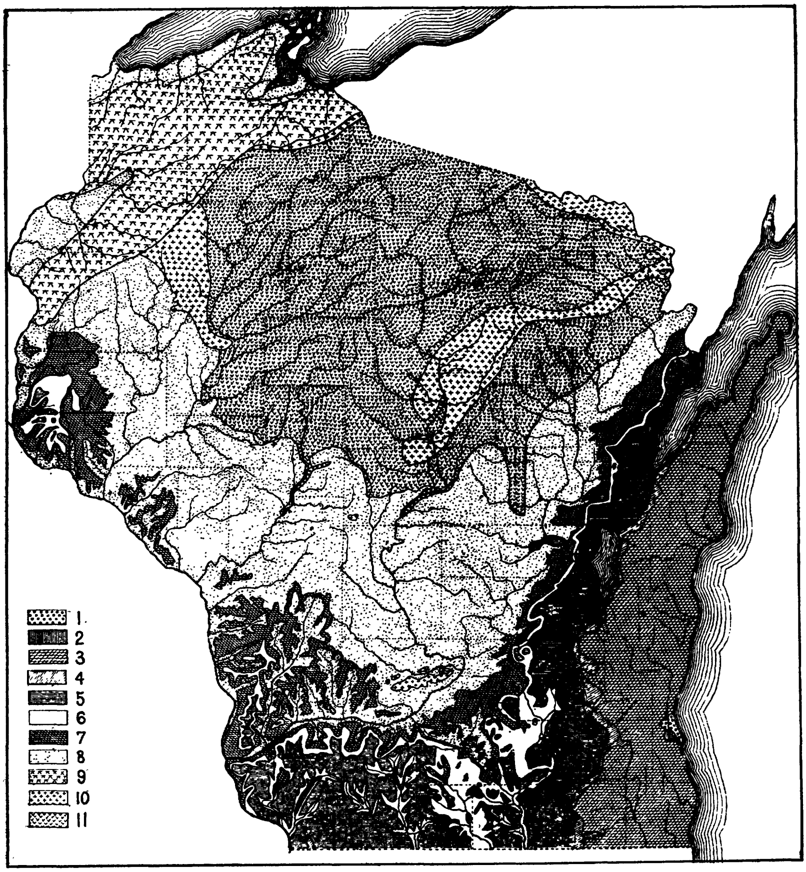

Fig. 1—General Geological Map of Wisconsin, reproduced from Geology of Wisconsin, Vol. I. Scale, 1:4,500,000.

1, Hamilton Cement Rock; 2, Lower Helderberg Limestone; 3, Niagara Limestone; 4, Hudson River Shale; 5, Trenton (and Galena) Limestone; 6, St. Peters Sandstone; 7, Lower Magnesian Limestone; 8, Potsdam Sandstone; 9, Keweenawan or Copper-bearing Group; 10, Huronian or Iron-bearing Group; 11, Laurentian Group.

ties (for location of counties see Fig. 4). The Keweenawan or copper-bearing group outcrops all across the northern part of the state from the Michigan line at Lake Superior to Minnesota. The Douglas Copper Range is formed by the faulting of these formations. Paleozoic formations dip away from the pre-Cambrian center and are exposed in bands, the older and lower ones outcropping near the center and the younger and higher ones farther away (Fig. 1). The nonresistant Paleozoics, the Potsdam sandstone, St. Peters sandstone, and Hudson River shale lie below the Lower Magnesian, Trenton-Galena, and Niagara limestones respectively. The limestones are resistant and therefore outcrop as ridges, whose eastern and southern dip slopes are long and gentle and whose western and northern slopes are precipitous in many places and bare of vegetation. The ridges are much cut by streams and reduced by glaciation.

Speaking in general terms, Wisconsin has a rolling surface of moderate elevation, averaging 1,050 feet above sea-level. The altitude varies from 600 feet to 1,800 feet, the latter height being reached at but one or two points. Although without great relief, the surface is far from level; there are many small, nearly level plains, and there is much land which is quite rough.

The most important topographic feature in the state, historically, is a remarkable depression which extends across it from Green Bay to the mouth of the Wisconsin River (Fig. 2). This is known as the Fox-Wisconsin depression and is continuous except for a mile and a half over the low divide at Portage. This depression was of great importance in the early history of the state as a route of travel and commerce between the Great Lakes and the interior.

The most conspicuous elevations are Military Ridge and the Winnebago Escarpment. Military Ridge[1] extends in an east-west direction between Madison and the Mississippi River, parallel with and nearly 15 miles south of the lower Wisconsin River. Along the crest of this ridge was built the western part of the military road between Green Bay and Prairie du Chien, one of the earliest and best known roads in the state. More striking than Military Ridge is the Winnebago Escarpment. Beginning on Door Peninsula, it extends southwest to Lake Winnebago, turns south along the eastern shore of the lake, dies out toward the south and is buried finally under the drift in the southern part of the state. Between Green Bay and Lake Winnebago it forms the high east bluff of the Fox River, attaining an elevation of 1,200 feet above sea at the lake. When Nicolet first came to Wisconsin the Indians had a fort on this bluff at Green Bay. Another fort guarded the outlet of Lake Winnebago and enabled the Indians to collect toll from boats passing this point. These escarpments are caused by an outcrop of hard Niagara limestone above nonresistant Hudson River shale.

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[1] Collie, Geo. L.: Physiography of Wisconsin, *Bull. Am. Bur. Geog.*, Vol. 2, p. 273.

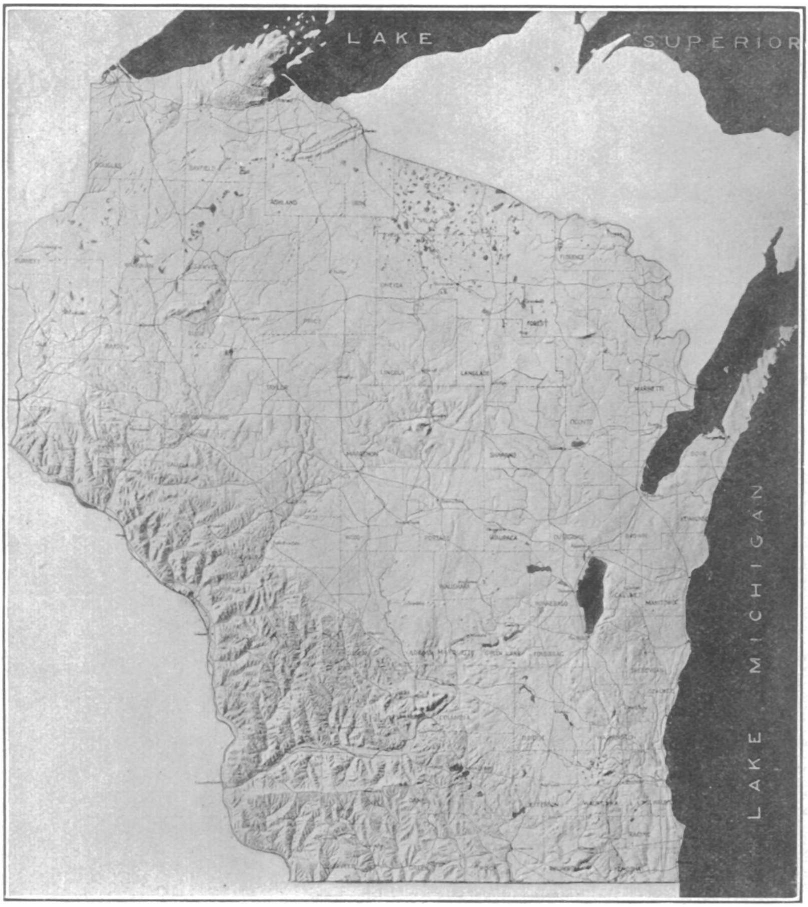

FIG. 2—Relief Map of Wisconsin, by permission of the Wisconsin Geological Survey. Scale, 1:4,600,000.

More than four-fifths of Wisconsin is covered by glacial deposits (Fig. 3). Most of the drift was deposited by the last Wisconsin glacier, but older drift occurs in the southern part of the state in Rock, Green, and Dane Counties, and again in the north central part, from Wood and Marathon Counties west to the Mississippi

River. The area of older drift has some of the characteristics of the younger drift area and some of those of the driftless region. The glacial deposit is thinner than that on the more recently glaciated region and consequently controls the topography to a less degree. The rivers are mature and the drainage is good. The surface covered by the later drift has the character of a typical ground moraine; young valleys, marshes, lakes, undrained depressions, low hills and drumlins, a generally rolling surface, broken here and there by a nearly flat lake bed or outwash plain. Near the edge of the last Wisconsin drift is the Kettle Moraine, which is the

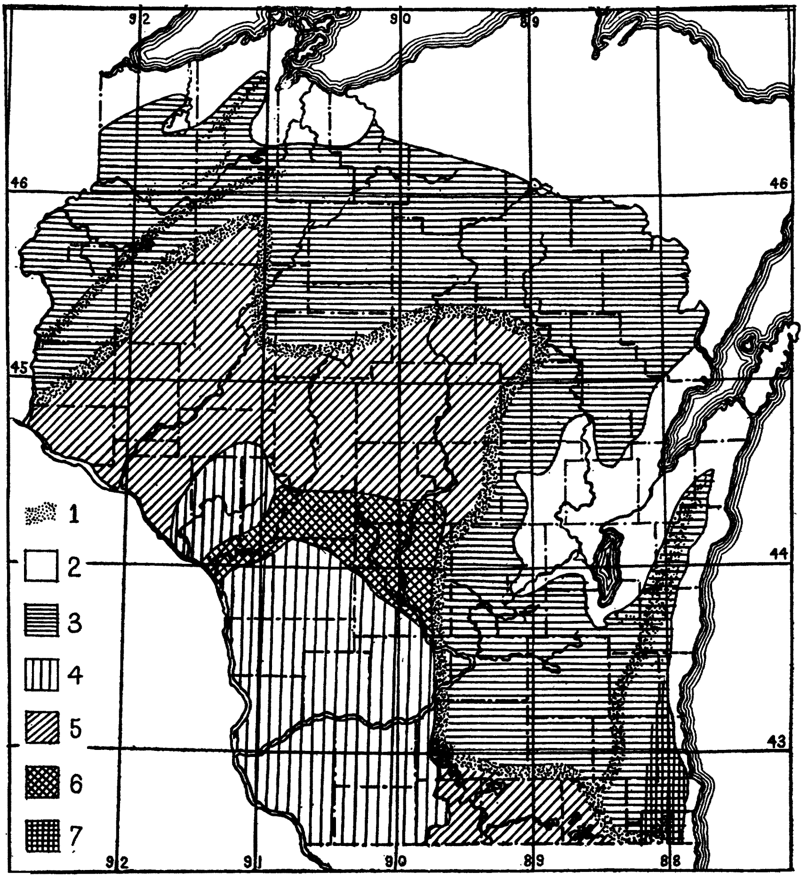

FIG. 3—Glacial Map of Wisconsin. Scale, 1:4,500,000.

1, Kettle Moraine; 2, red pebble clays (subaqueous) and associated beach and shallow-water deposits; 3, drift of the second Glacial Epoch; 4, driftless area; 5, drift of the first Glacial Epoch; 6, lacustrine and fluviatile drift beyond the general drift area; 7, gray pebble clay (subaqueous).

terminal moraine of the last great ice-sheet. It lies in great loops, formed by the lobes of the glacier. Beginning on Door Peninsula it extends south-southwest to Walworth County. Here it loops to the west and then extends north along the Wisconsin River to Langlade County, from where it has a zigzag course to the Mississippi River at River Falls (Fig. 3). The Kettle Moraine is a distinct topographic feature. It has a belt-like form and an uneven surface, on which kettles and kames of unusual size are frequent. While the soil on the Kettle Moraine compares favorably with that of many of the more level parts of the state, its irregularity of surface in many places precludes its use for cultivation and makes it a grazing region or a timber country.

Beyond the Kettle Moraine there are in places outwash deposits of considerable size, whose surfaces slope gently from the moraine. Most of these outwash plains are very fertile, and they include some of the best farming land in the state.

In contrast with the glaciated region is the driftless area, which occupies some 10,000 square miles in the southwestern part of the state. The region was once a plain in which the streams have deepened and widened their valleys until the remnants of the old plain appear as ridges between the low flat valley bottoms. As a whole the area is in a mature stage of erosion, but there are places where it is still young and others where it is well advanced toward old age. The bed rocks are nearly horizontal. The valleys are steep-sided and usually 150 to 200 feet deep. The drainage is good; there are neither lakes nor marshes. In the southern part of the area, where the surface rock is of limestone, the remnants of the old plain take the form of "dome-like mounds,"[2] of which the Blue Mounds, lying 25 miles west of Madison, are the best examples. The Blue Mounds are monadnocks covering 5 square miles and having an elevation of 1,729 feet. Farther north, where the more easily eroded Potsdam sandstone is the prevailing rock, the erosion remnants have a different form, and we find the peculiar architectural effects of the Camp Douglas plain.

The earliest settlements of importance in the state were in the lead region in the unglaciated area (Fig. 8).* The working of the mines and the market produced thereby proved an attraction for a small agricultural population. When the great agricultural settlement of the state began in 1832 the unglaciated area was neglected somewhat for the drift plains farther east. In 1847 there was almost no settlement north and west of the Wisconsin River (Fig. 9).* In general the percentage of improved land and the density of population is less in the unglaciated counties than in the glaciated area. The value of farm land is less in the unglaciated area, and the average size of the farms is greater than in the glaciated area. The soils of the glaciated area are more varied, inviting a greater diversity of crops, and the topography is less rough, giving a greater area of tillable land than in the driftless region. The amount of water power is much greater in the drift covered area, and it determines to some extent the location of the manufacturing plants.

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[2] Collie, G. L.: *op. cit.*, p. 278.

* Will illustrate Chapter III.—Ed.

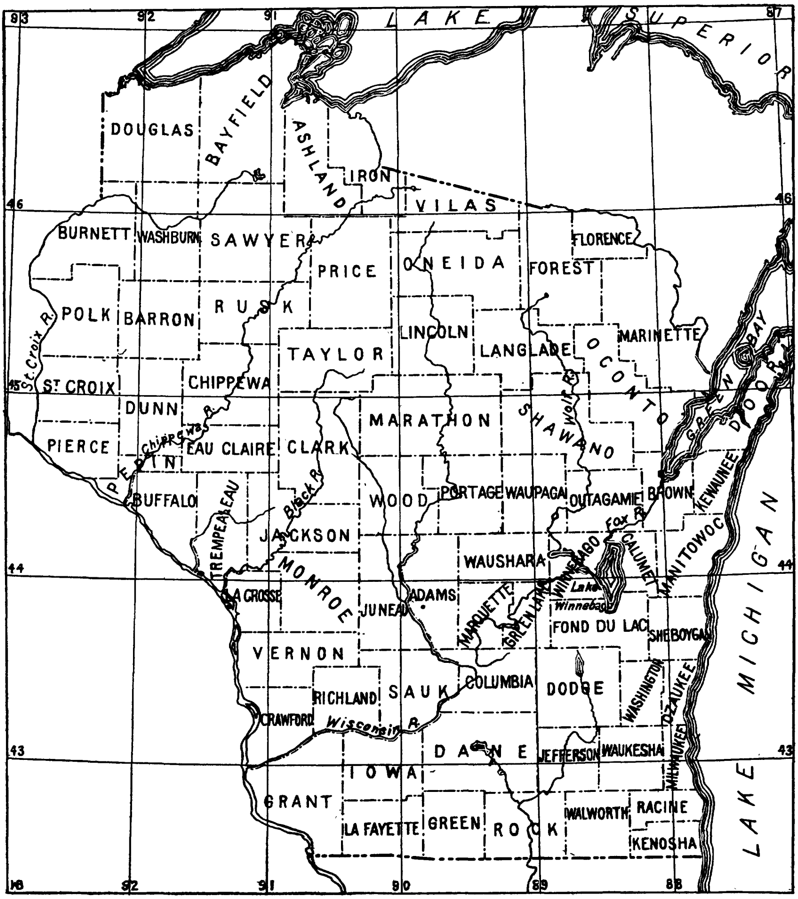

FIG. 4—County Map of Wisconsin. Scale, 1:4,500,000.

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* Will illustrate Chapter III.–ED.

Wisconsin is divided into two main drainage areas, one sloping north toward Lake Superior and the other sloping radially toward Lake Michigan and the Mississippi River. The watershed separating these two slopes "is a wide and nearly flat tableland" with a height of 600 feet above Lake Superior "on the Minnesota border and over 1,000 feet on the Michigan line. Its average distance from Lake Superior is 30 miles."[3] (Fig. 2.)

The drainage slope of Lake Superior has, in general, three distinct types of topography. The southernmost belt "consists of a plateau, in large part covered with swamps and lakes and is so flat that in many cases water from the same swamp may flow either north to Lake Superior or south to the Mississippi."[4] From this tableland there is a gradual descent northward to the Penokee and Douglas Ranges, which rise 600 to 900 feet above the lake. The northern face of the ranges is a fault scarp, which makes that slope more abrupt than the southern. It is at this point, where the Lake Superior rivers cross the ranges, that stream gradients are greatest and falls and rapids most numerous. Here occur Copper Falls near Mellen, where Bad River makes a descent of 60 feet; Tyler Forks Fall, where Tyler Fork of Bad River drops 45 feet into its main; the Dalles of the Bois Brulé River; and the Rapids and falls of Black River, where the river makes a total descent of 200 feet in 4 miles just before it joins the Nemadji. Between the highlands and Lake Superior is a plain 5 to 15 miles wide, which ends in wave-cut cliffs along the shore of Lake Superior. The red sandstone of the cliffs is quarried in a number of places along the shore of the mainland and also on some of the Apostle Islands. The surface of the plain consists of till and thick layers of red clays, mixed in places with sands. The streams have cut steep-sided valleys in this loose material, 25 to 100 feet deep, making railroad and highway construction expensive.

South of the general divide noted above the land slopes radially to the southeast, south, and southwest, and supports several large rivers. All the more important rivers, except the Rock, begin and end within the state. In general, each of these rivers may be divided into three parts which have distinct characteristics. "First, the head waters marked by sluggish streams with low divides, fed by numerous and extensive swamps and lakes, frequently so interlaced that it is impossible to trace the water divides."[5] Boulder rapids frequently occur in the upper courses. "Second, a stretch of maximum descent along the center reach of the river, abounding in numerous falls and long stretches of rapids.[6] This part of the river is always in the regions of the pre-Cambrian crystalline rocks, the southern border of which marks the lower limit of the rapids."[6] "Third, the lower portion of the course, where for a distance of about 50 miles the river flows through sandstone and limestone, the descent being very slight. This region is therefore devoid of water power. In fact, the United States government has improved the larger rivers along this reach for the purpose of navigation without the use of locks." [6]

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[3] Smith, L. S.: Water Powers of Wisconsin, *Wis. Geol. and Nat. Hist. Surv. Bull. XX*, p. 251.

[4] Smith, L. S.: *op. cit.*, p. 250.

[5] Smith, L. S.: *op. cit.*, p. 10.

There are only two important exceptions to the rule that the falls and rapids occur in pre-Cambrian crystalline regions. One is The Dells of the Wisconsin at Kilbourn, where, having been forced out of its old channel by the glaciers, the river has for a distance of 7 miles cut a deep, narrow gorge in the Potsdam sandstone. From a width of 1,400 feet the channel narrows suddenly to 200 feet and at "The Narrows" to 40 feet. Through this gorge the water flowed at a rapid rate until ponded back by the recently constructed dam at Kilbourn. The other exception is the water power at Eau Claire at the junction of the Chippewa and Eau Claire Rivers, both of which flow over Cambrian sandstone. The falls and rapids in the area of crystalline rocks are due to a lack of adjustment of the streams to their beds. The streams originated on the Paleozoic rocks which once covered this region and wore their beds down through these strata to the pre-Cambrian rocks. They continued to sink their channels into the resistant rocks with the same meandering courses that they had acquired on the softer Paleozoics. The streams were compelled to flow over rocks of varying hardness, and falls and rapids were developed.[7] At the edge of the pre-Cambrian and overlying Paleozoics the soft sandstone has been largely removed and the "recently superimposed streams are just beginning to sink their valleys into the underlying crystallines." [8] Along this line are located the towns of Chippewa Falls, Neilsville, Black River Falls, Centralia, Grand Rapids, and Stevens Point, each with important water power. The area of pre-Cambrian rocks did not encourage early settlement. It was covered by pine forests and the lumber interests drew the first population, which was more or less transient. Agricultural settlement was made very slowly because of the unpromising prospects offered by the cut-over pine land. The location of all the large towns has been determined by the presence of rapids or falls, which also determined the location of the first sawmills. The future of the crystalline area will no doubt be very different from its past history.

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[6] Smith, L. S.: *op. cit.*, p. 10.

[7] Weidman, S.: The Geology of North Central Wisconsin, *Wis. Geol. and Nat. Hist Surv. Bull. XVI*, p. 620.

[8] *Ibid.*, p. 621.

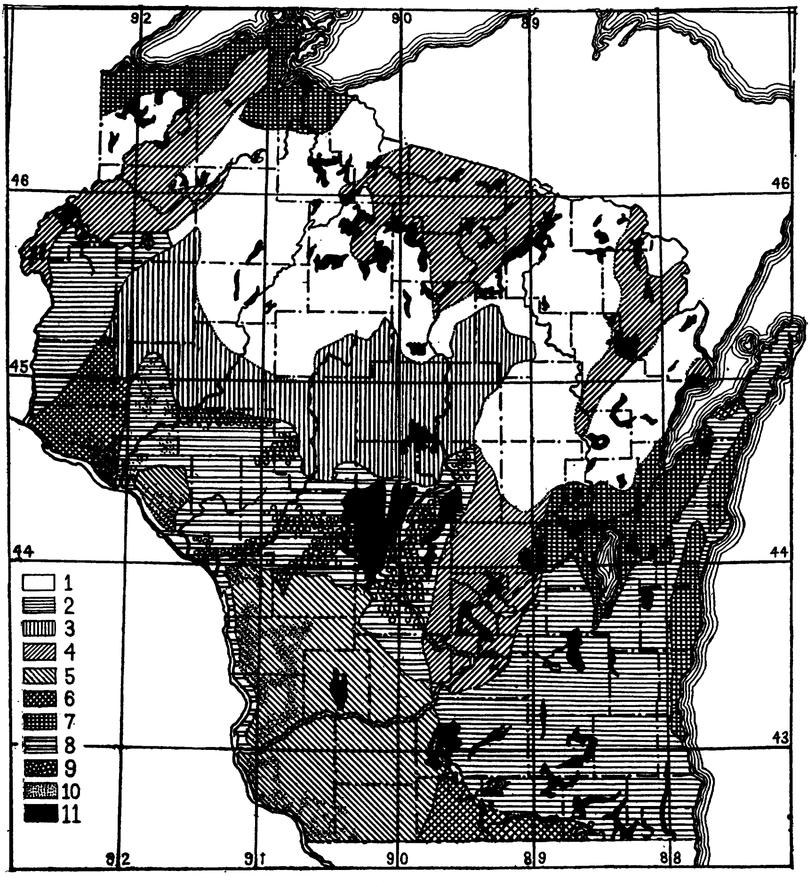

FIG. 5—General Map of the Soils of Wisconsin. Scale, 1:4,500,000.

1, last glacial clay on crystalline rock; 2, last glacial clay on lime and sandstone; 3, old glacial clay on crystalline rock; 4, sandy soils of last glacial period; 5, residual clay on lime and sandstone; 6, old glacial clay on lime and sandstone; 7, red clay, chiefly of lacustrine origin; 8, residual sandy loam; soils of Potsdam sandstone; 9, residual sandy soils of Potsdam sandstone; 10, loess; 11, muck and peat.

As the industrial interests of the state develop, the value of the water power will increase, particularly in view of Wisconsin's lack of coal. Important industrial cities probably will develop in the future in north central Wisconsin. So far as known not a single important river in the state has been made to fully yield its available water power. "The lower Fox has been developed most completely, having produced a total of 31,898 horse power"[9] in the 35 miles between Lake Winnebago and Green Bay. In 1905 the amount of water power developed in the state was "only 124,400 horse power."[9]

Mineral products[10] of commercial value are neither numerous nor extensive in Wisconsin. Iron is found in the Huronian rocks of the northern part of the state, and near Baraboo. The Potsdam sandstone yields iron at several points in Richland, Crawford, Vernon, and western Sauk Counties, and Clinton iron ore is mined at Iron Ridge and Mayville in Dodge County.

The Keweenawan, or copper bearing, rocks have never yielded copper in quantities of commercial importance in Wisconsin, although the same formations give large returns in the northern peninsula of Michigan.

The Trenton-Galena limestone in the southern part of the driftless area has been mined for lead and zinc since the French first taught the Indians the use of lead in fire arms and its value as a medium of exchange. This source of wealth has had a distinct bearing on the history of the state from the earliest records down to the present time.

Building stone is plentiful and of good quality. The pre-Cambrian rocks are quarried for granites, porphyries, quartzites, and gabbros ("Duluth Granite"). White and brown sandstone come mainly from the Potsdam, although St. Peters, while usually very soft, yields some stone of value. The Niagara formation of the eastern part of the state yields a good limestone, as does also the Trenton-Galena in places.

The soils of Wisconsin are partly residual and partly transported soils. Those of the driftless area are mostly residual. There is some loess along the Mississippi River and alluvial material in the stream valleys, but in general the soil may be said to be the insoluble residue of the rock which once occupied its position. The soil map (Fig. 5) shows that the clay of the central and southern parts of the driftless area is the result of the disintegration of limestone, and that the sandy soil and loam of the northern part come from the Potsdam sandstone.

The transported soils of the drift-covered area are not so closely dependent upon the underlying rock for their constituents. Nevertheless, glaciers move the bulk of their load but a short distance from its source, so that the soil of the glaciated area consists of a large amount of material from the local bed rock, mixed with a smaller amount from all the formations which have contributed to the load. The soil of a lake, marsh or peat bog deposit is finer than ordinary drift and contains a higher percentage of humus. The lacustrine clays bordering Lake Michigan, Green Bay, and Lake Superior testify to the once greater size of these bodies of water. The numerous muck and peat deposits point to the presence of post-glacial lakes and marshes, now wholly or partly filled.

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[9] Smith, L. S.: Water Powers of Wisconsin, *Wis. Geol. and Nat. Hist Surv. Bull XX*, p. 1.

[10] Geology of Wisconsin, Vol. I, Pt. III: Economic Geology.

The climate of northern Wisconsin is characterized by a large amount of sunshine with high temperature in summer, and extreme cold, deep snow, and clear skies in winter. The summer heat and winter cold are generally tempered by the influence of Lakes Michigan and Superior, which cover an area of 54,000 square miles and never freeze over in winter. The prevailing wind is from some westerly quarter, but this is broken up so frequently by the passage of storm centers that the winds often come from over the lakes and affect both the temperature and humidity of the air. The extreme southern part of the state is considerably warmer than the northern part, having less of extreme cold and deep snow in winter but having a greater degree of heat in the summer. The rivers of the state are generally frozen between December 1 and March 30. "The average rainfall for twenty-five years over the entire state is close to 32.3 inches, distributed by seasons as follows: winter, 4.7 inches; spring, 7.6 inches; summer, 11.7 inches; autumn, 8.3 inches. It is worthy of note that 60% of the rainfall comes in the summer and autumn months, while the least fall is during the winter months."[11]

The difference in the climate of the northern and southern parts of the state has made a difference in their development. The milder climate of the southern part encouraged its earlier settlement, and also permits the extensive cultivation of maize, which is almost prohibited in the northern part by the shortness of the growing season.

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[11] Smith, L. S.: Water Powers in Wisconsin, *Wis. Geol., and Nat. Hist. Surv. Bull. XX*, p. 15.

(*To be continued*)